Theoretical Studies of Josephson Arrays, High Temperature Superconductors, and Inhomogeneous Media

David Stroud, Ohio State University

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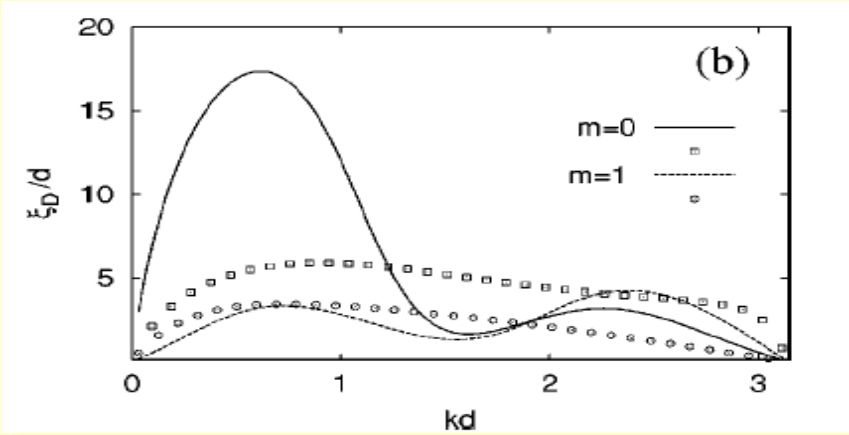
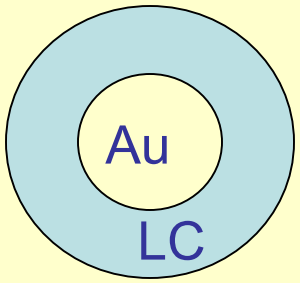
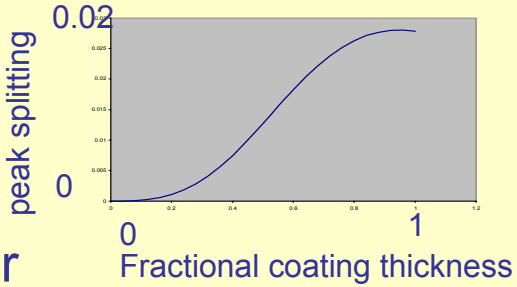
- Research Highlight: Advances in Nano-optics.
- Nano-optical materials are structured at the scale of 0.000001 m. They have unique optical properties.
- We have calculated propagation of energy along nanoparticle chains at speeds up to 1/10 the speed of light – consistent with experiments at Caltech.
- We have also showed that light traveling through suspensions of nanoscale metallic particles can be controlled by electric fields (by immersing particles in liquid crystals). Many possible applications.



Upper solid line: calculated velocity of energy along chain for closely spaced gold nanoparticles: maximum is typically around 0.1 x speed of light





Left: Spherical gold particle coated with liquid crystal (LC): absorption controlled by applied electric field. Right: calculated absorption peak splitting at various coating thicknesses (in units of plasma frequency)..

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- **Some potential applications:**
- Chains of metallic nanoparticles can carry energy at high velocities and even around corners.
- Liquid-crystal coated metal nanoparticles can be used as controllable optical elements, since LC controlled by applied electric field.
- This work is being incorporated in PI's physics courses at OSU
- Publications: Park and Stroud, Phys. Rev. B69,125418 (2004), and Appl. Phys. Lett. (in press).

Education:

Seven grad students (Eivind Almaas, Sergey Barabash, Wissam Al-Saidi, Daniel Valdez-Balderas, Ivan Tornes, Kohjiro Kobayashi, and Kwangmoo Kim) and two postdocs (Sung Yong Park and Ha Youn Lee) have contributed to this work.. Almaas, Al-Saidi, and Barabash now have postdoctoral positions at Notre Dame, William & Mary, and NREL (Golden, CO. Park has a postdoc at Northwestern.